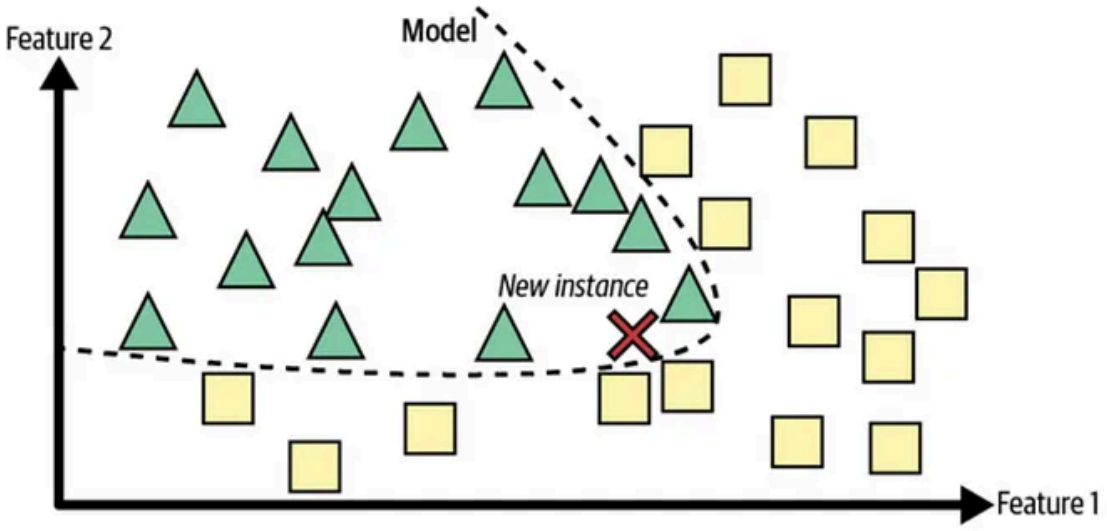
Model Based

Model-based learning involves creating a mathematical model that can predict outcomes based on input data. The model is trained on a large dataset and then used to make predictions on new data. The model can be thought of as a set of rules that the machine uses to make predictions.

In model-based learning, the training data is used to create a model that can be generalized to new data. The model is typically created using statistical algorithms such as linear regression, logistic regression, decision trees, and neural networks. These algorithms use the training data to create a mathematical model that can be used to predict outcomes.



Advantages of Model-Based Learning

- **Faster predictions**: Model-based learning is typically faster than instance-based learning because the model is already created and can be used to make predictions quickly.

- **More accurate predictions:** Model-based learning can often make more accurate predictions than instance-based learning because the model is trained on a large dataset and can generalize to new data.

- **Better understanding of data:** Model-based learning allows you to gain a better understanding of the relationships between input and output variables. This can help identify which variables are most important in making predictions.

Disadvantages of Model-Based Learning

- **Requires a large dataset:** model-based learning requires a large dataset to train the model. This can be a disadvantage if you have a small dataset.

- **Requires expert knowledge:** Model-based learning requires expert knowledge of statistical algorithms and mathematical modeling. This can be a disadvantage if you don't have the expertise to create the model.

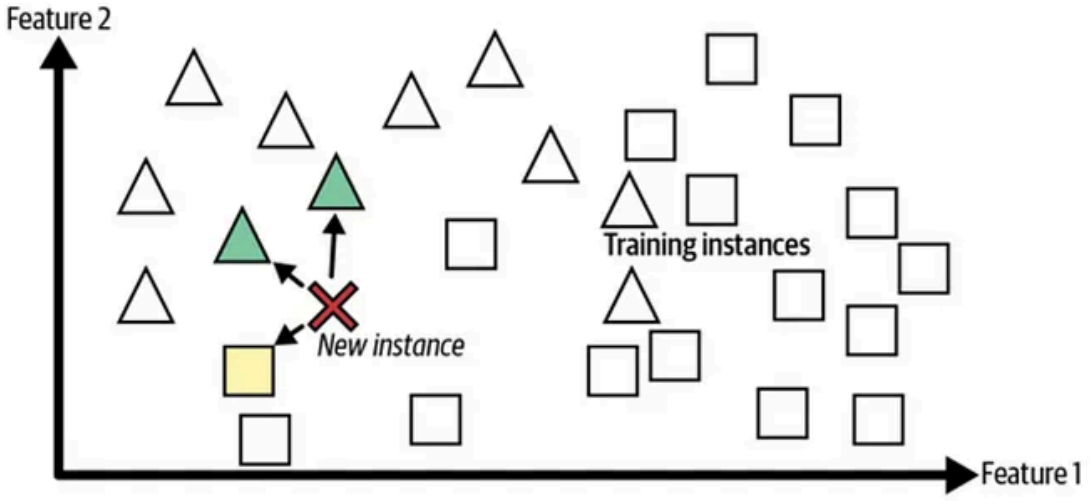
Example of Model-Based Learning

An example of model-based learning is predicting the price of a house based on its size, number of rooms, location, and other features. In this case, a model could be created using linear regression to predict the price of the house based on these features. The model would be trained on a dataset of house prices and features and then used to make predictions on new data.

Instance Based

Instance-based learning involves using the entire dataset to make predictions. The machine learns by storing all instances of data and then using these instances to make predictions on new data. The machine compares the new data to the instances it has seen before and uses the closest match to make a prediction.

In instance-based learning, no model is created. Instead, the machine stores all of the training data and uses this data to make predictions based on new data. Instance-based learning is often used in pattern recognition, clustering, and anomaly detection.



Advantages of Instance-Based Learning

- **No need for model creation:** Instance-based learning doesn't require creating a model, which can be an advantage if you don't have the expertise to create the model.

- **Can handle small datasets:** Instance-based learning can handle small datasets because it doesn't require a large dataset to create a model.

- **More flexibility**: Instance-based learning can be more flexible than model-based learning because the machine stores all instances of data and can use this data to make predictions.

Disadvantages of Instance-Based Learning

- **Slower predictions**: Instance-based learning is typically slower than model-based learning because the machine has to compare the new data to all instances of data in order to make a prediction
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- **Less accurate predictions:** Instance-based learning can often make less accurate predictions than model-based learning because it doesn't have a mathematical model to generalize from.

- **Limited understanding of data**: Instance-based learning doesn't provide as much insight into the relationships between input and output variables as model-based learning does.

Example of Instance-Based Learning

An example of instance-based learning is the k-nearest neighbor algorithm. This algorithm involves storing all instances of data and then using the closest k instances to make a prediction. For example, in a classification problem where the goal is to predict the species of a flower based on its petal length and width, the k-nearest neighbor algorithm would store all instances of flowers along with their species and petal length and width measurements. When a new flower is presented, the algorithm will find the k closest instances based on their petal length and width measurements and then assign the species of the majority of those k instances to the new flower.

Comparison between Model-Based vs Instance-Based

Usual/Conventional Machine Learning	Instance Based Learning
Prepare the data for model training	Prepare the data for model training. No difference here
Train model from training data to estimate model parameters i.e. discover patterns	Do not train model. Pattern discovery postponed until scoring query received
Store the model in suitable form	There is no model to store
Generalize the rules in form of model, even before scoring instance is seen	No generalization before scoring. Only generalize for each scoring instance individually as and when seen
Predict for unseen scoring instance using model	Predict for unseen scoring instance using training data directly
Can throw away input/training data after model training	Input/training data must be kept since each query uses part or full set of training observations
Requires a known model form	May not have explicit model form
Storing models generally requires less storage	Storing training data generally requires more storage